DATA PROCESSING DIGEST

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General Information

MANAGEMENT INFLUENCE ON THE DESIGN OF DATA PROCESSING SYSTEMS

Edward L. Wallace, University of Buffalo
Published by Graduate School of Business Administration, Harvard University, 1961. $3.00

This case study is the second in a four-part series planned by the Graduate School of Business Administration of Harvard. The first study was the well-known "Company Investigations of Automatic Data Processing," by Peter Laubach ((See DPD: April 1957, page 6; Idea Finder, page 36)). Mr. Laubach dealt with the first stage of the automatic data processing problem, the general question as to whether automatic data processing equipment should be acquired. The second study is concerned with the next stage, the detailed investigation of a specific data processing problem, recommendations for a system and its associated equipment. Subsequent studies will be published on the installation of the system and equipment, and its use in operations.

CONTENTS

1 General Information
12 Equipment
13 Programing and Operation
16 Management Sciences
17 Points of Interest
19 Comment
21 Training
21 Meetings
23 References

The second study concerns a manufacturing company, represented in this case as a shoe manufacturer. The study shows how disillusioned management, burned twice on poorly-designed punched card systems, placed restrictions on its third investigating committee which prevented the committee from doing an adequate job of integrated procedures design, and forced it to concentrate instead on selecting equipment which would merely perform certain existing procedures more quickly and economically. The case study shows how the plan went wrong, and suggests an alternative plan which would have achieved the desired results.

The author's conclusions are worth summing up briefly, to give a feel for the general thesis of the case study:

1. Design of an automatic data processing system for control is a two-part undertaking, design of information processing and development of equipment.

Management must want EDP

2. Limitations that management sets in advance on the areas of data processing to be included in a study and on the time allowed for the study should be flexible enough to permit consideration of new matters arising in the course of the study.

3. Management should make special efforts to direct a study toward realization of the potential for improving both the types of information made available for the purposes of planning and the current ways of using that information.

4. Company personnel are likely to produce better results than outsiders.

5. The investigators should make recommendations that will not limit opportunities for growth in use of the equipment chosen.

"The design of an over-all control system that is meant to take maximum possible advantage of automatic data processing equipment requires the redesign of the existing information system to include improvements in information content and processing and in management's use of this information. Detailed familiarity with computers and with the selection and design of electronic equipment is of little importance in this phase of the study. The redesign of information processing procedures requires persons who understand the planning problems of management and are able to see the relationships between separate types of planning and to alter current planning procedures so as to make them more effective and better coordinated.

"Top management's role in achieving successful results is to recognize the importance of this objective, to communicate this recognition to the persons making the study, and to refrain from imposing arbitrary time and area limitations upon what is in effect a form of research."

IMPACT OF ELECTRONIC DATA PROCESSING ON MANAGERS

Peter W. Melitz, IBM, Dallas, Texas
ADVANCED MANAGEMENT, April 1961; pages 4-6

Rather than complete centralization of management and information processing, "it probably would be more accurate to say that EDP gives business and industry the means to support decentralized local management with better facts for local decision-making as developed by central computer accumulation of information. At the same time, a computer will centrally accumulate business intelligence from the whole of a business for better broad policy making at top management levels."

Data processing managers will be accepted as senior administrative executives, and there will be a "tremendous upgrading of systems and methods personnel." Managers must "learn to look on the computer as a profit-making tool." Decisions may become more factual and less intuitive through the use of simulation, forecasting, linear programing, least cost estimating and scheduling. Such techniques should be used only to pre-test decisions. Managers must be willing to modify their existing organizational responsibility, resolve interdepartmental differences, and resist the tendency to ask for more reporting from the EDP system than is necessary.

PERT—A MANAGEMENT CONTROL SYSTEM

Published by Sperry Gyroscope Co.

This is a PERT System Computer Manual, written for use with Univac II. The manual describes "a completely automatic computer system involving no manual intervention from initial key punched transactions to production of the final report. This system includes eleven computer runs in the areas of validity checking, master file updates and maintenance, calculations, and editing for reports from the High Speed Printer."

The system described in the manual was used by Sperry Gyroscope Company to perform multi-network processing. A limited number of the manuals is available from Remington Rand Professional Services Department, 315 Park Avenue South, New York 10, New York.

TOMORROW'S INTEGRATED OFFICES AND PLANTS

George M. Muschamp, Minneapolis Honeywell, Philadelphia, Pa.
AUTOMATION, May 1961; pages 46-51

Two kinds of information are acquired about production processes: information that is automatically taken which automatically controls specific processes; and information about the plant that is automatically or manually taken for decision-making and action-taking purposes. This second class of information is used primarily in office processes and results either in information as an end product, or as information incidental to the manufacture of a product. Information having to do with the manufacture of a product is closely related both to the office and to the plant.

Many of these functions can be merged, "so that the information, in addition to serving as a record, can be fed automatically into the plant control systems as required. We can automatically acquire, from the process, the information needed for automatic control of the process together with the information needed for accounting." Information for automatic control must contain performance versus a criterion. Control systems may be built step by step. For example, a large metropolitan electric company will have an on-line digital computer to link generators in each generator station in a machine control system for keeping constant outputs despite variations in load to meet changing power demands. To complicate the picture, further variables must be entered whenever the company buys power from or sells power to another company as demand dictates. The system will obtain data for intercompany billing of the delivered power. Such complex systems demand the most advanced systems engineering, and the use of mathematical models and other mathematical aids.

ELECTRONIC DATA PROCESSING—AN INTRODUCTION

E. W. MARTIN, JR., Indiana University
Published by Richard D. Irwin, Inc., Homewood, Ill. 1961. $10.60

This is a well written introductory text for college undergraduates or candidates for masters degrees, and equally acceptable for business people beginning a study of EDP. The book covers an extremely wide area, from a detailed description of the operation of an IBM 650 to the theory of management and information technology. It is organized well, and gives an excellent overall view of the subject, if a little heavy on the equipment side. However, the student or curious reader can readily pick and choose his way through the book, avoiding the hardware chapters if his interests lie more in an understanding of data processing or management control.

A valuable aid, particularly for those pursuing a self-study course, is the annotated bibliography at the end of each chapter. Diligence in searching out these references, for the most part readily available and well-known literature in the field, will give the student a deeper understanding of the chapter's theme. These references are well-chosen, and add an extra dimension to the coverage of the book itself. The book is well designed so that reading is easy and pleasant, with clear, understandable diagrams and charts. We would say this is a valuable addition to the small selection of good text books in the field, and has the advantage of covering more theory than is found in similar texts.

JOINT DATA PROCESSING FACILITIES FOR BANKS

Stanley R. Klion, Peat, Marwick, Mitchell & Co., Philadelphia, Pa.
BANKING, May 1961; pages 58, 59, 122, 124

Several problems which must be met by banks contemplating a cooperative EDP facility are: 1) operational feasibility, 2) facility feasibility, 3) economic feasibility, and 4) psychological feasibility.

Operational feasibility involves the kind of account numbering system each bank will want; the individual treatment of holds, stop payments, and similar activities; communication requirements; clearing house arrangements; forms in use; computation of service charges and interest, and similar matters. Facility feasibility includes consideration of time and scheduling of data runs; protection against data disclosure; independence of the facility management; quality of personnel; procedures to be followed in event of breakdown. Each bank should have an equal voice in management, and each participating bank should contribute equally to the cost of the study and retain an equal voice in making the decisions.

Co-op bureaus need careful planning

In considering economic feasibility of the cooperative facility, it is important to recognize all costs, including those of work which will have to continue being done in each bank. Operating costs should be distributed on an equitable basis. The construction of a proper schedule of charges is a difficult part of the planning. Some workable type of cost accounting arrangement must be developed so that facility management can have a proper fee schedule to recover operating costs. Also, start-up costs must be included, and the cost of indoctrination and other one-time costs are a part of the total cost that must be amortized.

Psychological feasibility means consideration of how well the member banks can work together and give and take as necessary. Day-to-day decisions must be made that may appear on the surface to favor one member, but which are necessary at the time for practical reasons. Furthermore, a joint facility is not the kind of a venture into which a bank should be persuaded to go. The bank must want to participate. At the outset, each bank will convert to the facility sequentially. Since one bank must go first, it may appear to the others that the first is getting a competitive, as well as an economic, advantage. While such need not be the case, the participants should recognize the need to proceed on this basis.

Two joint ventures have begun investigations into feasibility. One of these is a group of 20 savings banks, the other is a group of 25 small commercial banks. A successful prototype for cooperative computing facilities is the SPAN insurance facility in Hartford, Conn.

EDP: A FEW DO'S AND DON'TS

BANKING, May 1961; pages 60, 126

Don'ts: "Avoid the false assumption that communication among the planning staff is perfect. Avoid bowing to expediency in method revision to accommodate isolated instances rather than the total systems. Don't assume that your customer will perform as you request. Avoid excessive reports and journals extraneous to operating and audit control requirements. Don't panic! 'Walk, don't run, to the nearest employment agency when it appears that the roof is caving in.'"

Do's: "Have top management publicize to the entire bank family its decision to automate the operation. Start to create your present method flow chart well in advance of the conversion date.... Place responsibility for conversion on one man and give him authority to select his team and working conditions.... Hire a competent technician experienced in the use of the machines you select.... Fix responsibility for the performance of every part of the conversion and subsequent operation.... Give the man responsible for conversion the time and privacy to ride herd on every control built in the system[including]an optional processing routine in event of temporary equipment failure.... Teach your customer counter staff to understand their places in the program."

HOW WE MOVED TO MICR

BANKING, May 1961; pages 81-83

In a question and answer article, the comptroller of The American National Bank of San Bernardino, California, tells why and how his bank began to imprint its checks with MICR coding before it had actually entered its own program for mechanization. Greater speed and higher volume, with the ability to handle new business without an increase in the number of machines or personnel were compelling reasons for their conversion to electronic methods.

DEVELOPMENT OF AN EFFICIENT ACCOUNT-NUMBERING METHOD

Richard E. Trueman, Touche, Ross, Bailey & Smart, San Francisco, Calif.
MANAGEMENT SCIENCE, April 1961; pages 265-279

An account numbering system is described which provides almost exact alphabetic and numeric sequencing even though the original file may grow by several hundred percent. The method is known as SANS, Simultaneous Alpha-Numeric Sequencing, and was developed by Henry F. Sherwood ((See DPD: July 1960, page 5, "SANS--A Simpli-

fied Account-Numbering System")). Original accounts are ordered alphabetically and then spaced $\underline{s}$ numbers apart. The numerical value of $\underline{s}$ is always chosen equal to $2^{\underline{k}}$, where $\underline{k}$ is integral. As each new account is received, it can then be given a number just half way between the two accounts which bracket it alphabetically. A new account falling alphabetically between two accounts already bearing consecutive numbers will be assigned a number in an overflow area. A mathematical description of number assignment is given in the article.

"AUDITING THROUGH" EDP EQUIPMENT

Robert N. Trombly, General Electric, Lynn, Mass.
N.A.A. BULLETIN, May 1961; pages 67-72

"It is probable that EDP equipment will have a full and far-reaching effect upon financial control long before it reaches any great degree of sophistication in the over-all operation to total business systems....due to the nature of financial information, with its general characteristics of inflexible rules of operation, consistency, mass volume of data, speed in handling and numerical results."

The new problems created by computers have "evolved around the characteristics of internal manipulation of data and consequent loss of 'audit trail.' The responsibility for control of 1) input of data to the machine, 2) people operating the machine, 3) people programming the machine, 4) the reliability of the machine, 5) the instructions given to the machine and 6) the output generated by the machine, resides solely in the hands of the controller. The auditor, being his chief delegate in the area of verification, must face each of these points and, after proper investigation, must be able to report on the validity and accuracy of the financial records produced by the machine."

An approach to verification of data accuracy

A possible approach to verification of accuracy and propriety in each of these points of control is suggested.

Input of data. Original documents must be regulated by principles of internal control to ensure that accurate data is fed to the machine. Such controls include control tape totals, batch totals, hash totals, self-checking numbers, etc. "The importance of this type of control is that it is derived and maintained outside of or independent from the machine and its operating personnel."

People operating the machines. These personnel are in positions of trust. Control procedures here include division of responsibility, rotation of work assignments, careful screening and recruiting policies, and protection by fidelity bond.

People programing the machines. Programers also occupy positions of trust and should have similar controls. Strict control should be exercised over any change in machine programs and all changes should be reviewed by the auditor before and after they are made.

Reliability of the machine. Controls may be initiated by programers' instructions or built into the machine. In the first case, an auditor can work with the programer to provide such controls as a record count, limit check, reverse multiplication, proof figures, cross-footing balance checks, check points, self-checking numbers, sequence checks, and labels. In the machine controls are parity bit check, double-track recording and reading, maintenance checks, and double circuitry.

"Audit trail" concept changes

Instructions given to the machine. Most auditors and controllers favor the complete "audit trail." However this requires transaction print-outs which burden the equipment and reduces some of the savings which could be made if the machine were allowed to report results only in the required final summarized form. An innovation by the auditor "will not only guarantee good control but also take advantage of the inherent benefits derived from the supression of insignificant detail, now permitted with this equipment. This innovation can be categorized into three separate areas: a) design and preparation of test conditions by the auditor, b) the test check or sample theory applied to internal processing and c) control by exception."

The output generated by the machine. Through a constant search for better reporting, the controller "will serve to further verify accuracy and propriety since good reporting suppresses the insignificant and outlines that which needs attention."

ADMINISTRATIVE EVOLUTION IN ADP IN STATE GOVERNMENT

Harry H. Fite, Univac Div., Sperry Rand Corp.
PUBLIC ADMINISTRATION REVIEW, Winter, 1961; pages 1-7

State governments have lagged behind the federal government in their use of EDP, although a number of states are using computers for highway and engineering computation. Some of the obstacles seem to be lack of funds, resistance to change, legal barriers, departmental forms of organization, and politics. Strong state departments tend to reflect weak central management, and strong budget machinery and administrative planning are the exception. This, along with a shortage of skilled manpower--not only in computer usage, but also government management--impedes the progress of EDP. Nor is centralization of EDP necessarily the best way of handling automation. Rather, the smaller scale computers in decentralized operation appear to be better for state use. In determining what decentralized departments could make best use of automation, two criteria should be applied: 1) how unique or discrete is the function performed, and 2) what is the volume of paperwork.

Some suggested functions for EDP are: public works, revenue administration, unemployment compensation, education, welfare, public safety, motor vehicle departments, beverage control, workmen's compensation, public health, correction or prisons, finance, personnel administration, and a central bureau for smaller departments' use.

ECONOMIC ANALYSIS AND DATA PROCESSING

G. E. Bissell, Remington Rand Univac
DATA PROCESSING (USA), May 1961; pages 7-9

A company's economist should make an analysis of the company's growth and potential development, "then make a detailed analysis of data processing. An understanding of the growth potential inherent in an industry will provide an exacting basis on which to assess the impact of data processing efficiencies on a firm's profit expectations."

TEACHING MACHINES AND PROGRAMMED LEARNING: A Source Book

Edited by A. A. Lumsdaine and Robert Glaser
National Education Association, 1960; $7.50

This excellent reference book (724 pages) presents most or all of the significant original papers on teaching machines and the techniques of instruction that are associated with them, up through 1959.

A survey of automatic teaching

The early chapters are papers concerned with S. L. Pressey's pioneering work with self-instructional test-scoring machines, at Ohio State University. The next series of papers deals with the important contributions of B. F. Skinner at Harvard University; Skinner's work has had very much to do with the present interest in teaching machines. A series of papers describe contributions from the military and from other sources. Included in these papers is a description of N. A. Crowder's interesting work with automatic tutoring and Tutor-Text Books ((see DPD: October 1960, page 1)). The final series of papers describe some recent work. Two sizable appendices are included. Appendix I is an annotated compilation of papers in the field of teaching machines and programed learning. Appendix II is a consolidated bibliography of all the references cited by authors of papers in this book, together with citations for the papers that are abstracted in Appendix I.

It seems apparent that teaching machines will soon have a very significant effect on our whole educational system. Important improvements in learning efficiency have been reported with the early machines and associated programing techniques. Some recent research work has tied a digital computer to the teaching machine, so as to better control the presentation of material to the student.

For anyone interested in the general subjects of education and teaching techniques, a knowledge of teaching machine developments would seem to be a "must." This book fills the need of making the important professional papers, describing the techniques and the theories behind them, available for ready reference.

THE COMPUTER-BASED CLASSROOM

DATAMATION, April 1961; pages 18-22

System Development Corporation has organized a research program on computer-based automated teaching, utilizing a Philco 2000 as a central control unit. The project is designated CLASS. The SDC staff will use the computer to instruct in individual, group, or mixed modes, where some students function independently while others work in small groups. Several hundred students could be simultaneously and individually tutored by a similar computer. For individual instruction, a manually operated film reader provides the student with learning material and a multiple choice response on the keyboard. For group instruction a random access slide projector, closed circuit TV, or the human teacher acts as the information source. Teachers or experimenters will monitor student learning behavior by means of four different devices: a display console, a Flexowriter, a read-out panel, or a film. Counselors will use an alphanumeric typewriter to call up student histories, and record diagnostic data. A high speed printer will provide administrators with immediate information on each student's state of academic knowledge.

Computer programs written for the CLASS project are in two categories: 1) the assembly of lessons, and 2) computer controlled instruction. The instruction control programs have many of the characteristics of the usual process control programs. Costs would be prohibitive for such teaching if a large computer were required for each school, but could be reduced to practical proportions on a cooperative basis. At present five schools in Richmond, California are being serviced by a central computer facility.

PROGRAMMING A COMPUTER TO TEACH

Don Englund and Don Estavan, System Development Corp., Santa Monica, Calif.
DATAMATION, April 1961; pages 20-22

A simplified history lesson is given to show the programing method for automatic teaching. "The lesson designer writes or selects a set of instructional materials covering the concepts within the subject matter to be taught, and prepares a flow of the lesson. The flow includes all of the items and logical decisions necessary for the lesson. This information is manuscripted, punched on cards, and processed by a Lesson Assembler Program. This Program reduces item information and decision description statements to tabular form. Finally, lesson information is output on tape."

THE ROLE OF THE DIGITAL COMPUTER IN THE UNIVERSITY

Alan J. Perlis, Carnegie Institute of Tech., Pittsburgh, Pa.
COMPUTERS AND AUTOMATION, April 1961; pages 10-15

Computers in universities are being used in three ways: computations for research programs; in numerical analysis; and in management gaming. However, the author believes training in computer use should be given all college students at some time during their college career in order to help them develop sensitivity, rationality, and research abilities. In engineering and science, courses in computers, mathematics and English would develop literacy during the freshman year, with physics and chemistry being courses in which such literacy would be applied. In liberal arts programs, sophomores would receive training in computers because of the "universal relevance of the computer to the problems of our time." An example is given of a course offered to 200 Carnegie Tech freshmen in which understanding of logical relationships in computer programing helped the students understand intuitively performed human tasks which can be translated into machine logic.

STEP BY STEP

William H. O'Keefe, Elmes and King Div. of American Steel Foundries
DATA PROCESSING (USA), April 1961; pages 20-24

Suggestions are given for the administrative work of installing a computer. The project director will have the responsibility for preparing conversion plans. It is suggested that on a separate sheet of paper for each department in the organization be listed every conceivable item or subject required or affected by the change. After listing, related items should be brought together and a common definition set down for each item or step.

From this data, the conversion schedule can be developed, along with the responsibility for each step. Department heads should be called together to complete the schedule and set responsibilities. A responsibility chart should be made, along with a chart summarizing the estimated time for each step. Each department should have a copy of the installation manual which contains copies of the responsibility chart and installation schedule. There should be a periodic review of progress, otherwise the work will slow down, and may eventually stop altogether. Meanwhile, organized training sessions should be carried on, beginning shortly after work on the installation has begun.

It is important to realize that the system will never become complete, but will change over a period of time. Procedures should be analyzed for their effectiveness and changed as policy is changed. Such changes and refinements in procedures should begin after the installation is completed. Samples of the charts mentioned above are included in the article.

CANADIAN IBM 1401 USERS TO POOL INFORMATION IN SPADE

OFFICE EQUIPMENT & METHODS, May 1961; page 48

SPADE, Systems Planning and Development Exchange, is a new IBM 1401 Users Association formed of Canadian firms using this computer. Semi-annual sessions will be held at Massey-Ferguson Ltd.

Equipment

THE PNEUMATIC COMPUTER IS ON THE WAY

AUTOMATIC DATA PROCESSING, April 1961; pages 18-20

A fluid amplifier, developed by scientists of the U.S. Army Ordnance Corps' Diamond Ordnance Fuze Laboratories, is leading to the design of pneumatic computers. Variations of fluid amplifier circuits can be used to form a variety of functional and logic devices, resulting in computers that are reliable and economically practical. A conservative estimate has been made that the pneumatic computer would perform at 10 percent of the cost of comparable electronic circuits. An experimental model has been built which has achieved a 25 microsecond pulse rate. There is evidence of Russian interest and activity in penumatic computer research, particularly for use in small-scale digital systems and for aircraft.

ASYNCHRONOUS COMPUTERS

Joan Kovacs, Philco Corp.
Paper published by Philco Corporation, Willow Grove, Pa.

A comparison is made between synchronous computers and asynchronous computers (such as the Philco 2000). In the former, each data processing operation is synchronized with the pulses produced by a master clock. In the asynchronous computer, there is no master clock. Instead, each successive operation is initiated by a signal that announces that the preceding operation has ended. Such computers do not have to wait for a pulse cycle. Immediately upon the completion of one instruction, the next instruction begins. New components can be added without major system redesign and rewiring. A copy of the paper may be requested from Marketing Department, Computer Division, Philco Corporation, Willow Grove, Pennsylvania.

MICROWAVE COMMUNICATIONS

R.R.I. EDP UPDATING SERVICE

The Retail Research Institute Updating Bulletin of March 15, 1961 contains a talk given by Joseph E. Keller of Dow, Lohnes and Albertson, at a special NRMA-RRI Microwave Briefing. This report described the status of microwave communications, both private facilities and public utilities facilities as they might apply to department stores with branch operations. For information about the report, write to Retail Research Institute, NRMA, 100 West 31st St., New York 1, N. Y.

Programing and Operation

COMPUTER SIMULATION OF HUMAN THINKING AND PROBLEM SOLVING

Herbert A. Simon, Carnegie Inst. of Tech.; and Allen Newell, Rand Corp., Santa Monica, Calif.
COMPUTERS AND AUTOMATION, April 1961; pages 18-26

General Problem Solver

A computer program called the General Problem Solver is called "general" because it accepts as tasks "all problems that can be put in a specified, but fairly general, form, and because the methods it employs make no specific reference to the subject matter of the particular problem it is solving. The General Problem Solver is a system of methods--believed to be those commonly possessed by intelligent college students--that turn out to be helpful in many situations where a person confronts problems for which he does not possess special methods of attack." In order to solve theorems, the GPS must be instructed in the rules of proof in the particular branch of mathematics to which the theorems belong. The processes are organized around goals of three types: 1) Transformation goals--to transform object a into object b; 2) Difference Reduction goals--to eliminate or reduce difference d between objects a and b; 3) Operator Application goals--to apply operator q to object a. One or more method is associated with each type of goal, the principal ones being three, one for each type of goal:

1. Method of transformation goals: to transform a into b,
   a. Notice a difference, d, between a and b;
   b. Establish the goal of reducing d between a and b;
   c. Try to attain this new goal;
   d. If successful, find a new difference and repeat.

2. Method for difference reduction goals: to reduce d between a and b,

   a. Recall an operator, q, that is relevant to differences of the type of d;
   b. Establish the goal of applying q to a;
   c. Try to attain this new goal;
   d. If successful, return to the previous transform goal.

3. Method for operator application goals: to apply operator q to a,

   a. Compare conditions for application of q with object a;
   b. If these are not satisfied, establish and try to attain the goal of transforming a into an object a' that meets these conditions;
   c. When the conditions are satisfied, apply q to a', and return to the previous difference reduction goal with the modified object, a', and the original object a.

"As a theory of human problem solving, GPS asserts....that if we compare that part of the human subject's problem-solving behavior which we can observe...with the processes carried out by the computer, they will be substantially the same." An abstracting process in the program "consists in replacing the objects, the differences, and the operators, with new symbolic expressions that describe the situation in much more general terms, omitting the detail." The processes incorporated in GPS have been observed in human subjects solving problems in the laboratory. The processes in GPS are "sufficient to produce a stream of behavior in a given problem situation quite similar to that produced by the human subject." The theory behind GPS is explained through the example of a child learning to speak.

AUTOMATIC MACHINE SCHEDULING

J. C. Hammerton, Stamford, Conn.
COMPUTERS AND AUTOMATION, May 1961; pages 17-22

"The need for improved techniques of machine scheduling arises from the emergence of business EDP into a production phase, the trend to multi-machine and multi-computer installations, the increased complexity of the over-all operations, and the pressure to reduce operating costs."

"Up-time" is no longer usable as the measure of usage efficiency. Rather the "ratio of occupied time to running time" is the yardstick. This ratio shows up "inadequate provision for the initial setting-up of an operation and...poor tape-changing procedures during an operation." As more computing equipment is added to an installation, scheduling becomes more complex. In addition, the trend to-

ward issuing unified management reports from many sources of data increases the interdependence of the data processing components. Finally, "emergence into a production phase is accompanied by pressure to reduce operating costs." All these factors suggest the necessity for automatic machine scheduling.

Prediction, Demand, and One-ahead scheduling

Three types of automatic machine scheduling are described. In Prediction Scheduling, a special computer run prepares all instructions for the day's (or shift's) operations. This will normally be done at the end of the previous day or shift. Changes in the predicted schedule are introduced through "change notices" which modify instructions already issued to operating personnel. This method is difficult to use in installations where a typical day's workload will include several such departures from the schedule.

The Demand Scheduling method schedules a new operation when the previous operation has been completed. Amendments to the scheduling data contained in storage are introduced through punched cards or paper tape. The computer then schedules the next operation on the basis of fulfilled prerequisites and established priorities. Demand Scheduling requires certain minimum capabilities in the system: any-to-any connections between the computers and the tape handlers; control switches governing these connections; and on-line printers accessible to all the computers in the installation. Tapes must be pre-mounted on the basis of predicted tape-handler assignments. This implies that a prediction schedule is made to forecast the probable course of the demand schedule. Instructions must be prepared to show the sequence in which the tape reels are to be mounted on each tape handler. Departures from the schedule may result in a tape-handler not being available when needed, or having the wrong tape mounted on it. This requires intervention by the shift supervisor.

Automatic tape library would be needed

"In order to extend true demand scheduling to the mounting of tape reels, the system capabilities must be extended to include automation of the tape library.... The most difficult part of this procedure.... is the actual mounting of the tape reel [which would require some radically new design of tape handlers].... With experienced tape clerks.... it appears that automating the extraction, issuance, routing, and transportation of the tape reels may be sufficient to permit demand-scheduling of the tape-handlers."

One-ahead Scheduling is a compromise method. "In order to gain some of the benefits of demand scheduling without incurring the cost of the extensions to the system the computers can schedule one operation ahead. At the start of one operation a computer schedules the operation which it will undertake at the conclusion of the operation it is about to start. This sequencing provides time for the mounting of tape reels."

A time-of-day clock is essential to an automatic machine scheduling procedure to record accurate historical data on the running times of operations. Fill-in work may be scheduled when the computer is unable to find another job to do. "It can be scheduled in increments of ten

to twenty minutes so that at the conclusion of an increment the computer can search the scheduling data again. However, AMS will not prove satisfactory in an installation characterized by routine, high-priority 'crash' work. Prediction scheduling requires a well-defined work-load with good historical records of input volume, output volume, and running times." Even demand scheduling requires the preparation of a predicted schedule at the start of a shift.

Management Sciences

PROGRESS IN OPERATIONS RESEARCH, VOL. I

Edited by Russell L. Ackoff, Case Institute of Technology
Published by John Wiley & Sons, Inc., 1961. $11.50

The Operations Research Society of America (ORSA) has planned a series of review volumes which document the progress and research in areas of operations research. The volumes will appear as the Society's Publication Committee sees the need, and will be edited by persons prominent in the field. In this, the first of these review volumes, twelve persons in the OR field are represented in the individual articles, in addition to the editor, Prof. Ackoff.

The articles include: decision and value theory, inventory theory from the OR viewpoint, mathematical programing, dynamic programing, dynamics of operations systems, sequency theory, replacement theory, simulation, military gaming, and a look into the future of OR. Each article is followed by a bibliography which gives a generous selection of references for cross-documentation of literature in that particular subject.

CYBERNETICS AND MANAGEMENT

Stafford Beer, United Steel Companies Limited, England
Published by John Wiley & Sons, Inc., 1960; $4.50

This 208-page book is one of the "classics" in the relatively new field of Operations Research. It effectively presents the basic concepts of cybernetics in (usually) easily readable form. Occasionally, the discussion becomes involved; students of cybernetics will want to study such sections, while the lay reader can skim through these sections without much penalty.

The author gives an arbitrary classification of systems: simple deterministic (example: billiards); complex deterministic (example: the planetary system); simple probabilistic (example: penny tossing); complex probabilistic (example: buying and selling stocks); and exceedingly complex probabilistic (such as the economy, the brain, or the company). Cybernetics deals with the self-regulatory type of control in complex, probabilistic systems.

For those to whom "cybernetics" has been just a word, this book will indicate the profound significance of the subject and the importance of developing methods of control for complex, probabilistic systems.

Points of Interest

A computer service center set up primarily for small banks has been organized by David S. Loudon of Summit, New Jersey. The new service will operate on a round-the-clock schedule to process checks and other banking documents at night, and payroll, inventory control, accounts receivable, and other commercial work during the day. Address: Loudon Computer Service, Inc., 25 Pine Ridge Drive, Summit, New Jersey.

A booklet describing what to do before installing a computer (system analysis, specifications, design and the full operation of the computer) is available from Philco Corporation, Computer Division, Willow Grove, Pennsylvania, Attn: Dept. N. P.

The American Documentation Institute has established a new office in Suite 413, 1025 Connecticut Ave., N. W., Washington 6, D. C. The publication, American Documentation has been enlarged, and Dr. Luther Evans, former Librarian of Congress and former Director General of UNESCO is the new editor. Subscriptions and advertising are handled by the American Institute of Biological Sciences, 2000 "P" Street, N. W., Washington 6, D. C.

RCA has announced that its 322 Paper Tape Reader/Puncher has been designed to solve the problem of "phantom holes" in punched paper tape, caused by oil spots. The new reader uses photoelectric scanning principles and improved circuitry to distinguish genuine holes.

IBM has introduced the IBM 1701 control system for process optimization, process study and manufacturing quality control. The system consists of the new 1711 data converter connected to the solid-state IBM 1620 computer.

The CODASYL Committee has released a progress report, copies of which may be obtained from M. H. Grosz, c/o Standard Oil Co., 30 Rockefeller Plaza, New York 20, New York.

The Burroughs B270 Electronic Data Processing System has been announced for complete banking operations. The system provides automatic proof and transit operations and converts "on-us" items to magnetic tapes. The system may also be used for automatic deposit analysis and account reconciliation.

The National Machine Accountants Association is establishing a Department of Education for which it is searching for a Director. The director will work with chapters and universities in planning educational materials and services. NMAA headquarters is: 1750 West Central Road, Mt. Prospect, Ill.

Associated Data Center, Inc. is the newly formed national organization of independent data processing service companies, organized to stress the highest standard of quality and service, and open only to those firms which meet the association's standards and who qualify as "small business" as defined by the Small Business Act of 1958. Information may be obtained from the secretary, Mel Forman, at Punch Card Services, 75 West Street, New York 6, New York.

S. J. Tesauro & Co. of Detroit is compiling survey statistics on sociological trends, changing economic currents, shifts in population, and other information vital to the planning of cities, new schools, parks, roadways, and other facilities. The company is using a Remington Rand Univac solid-state computer system. The first part of the project available June 1961.

System Development Corporation of Santa Monica, California, has received a grant from the United States Office of Education for research on the use of a computer-based teaching machine to select and organize education material for high school students. The resulting materials will be evaluated during several weeks of use in several Los Angeles area high schools.

Comment

AUTOMATIC PROGRAMING—PART II

In the June issue we discussed the problem-oriented language, in particular the two standard languages presently available: ALGOL, for the expression of numerical procedures for solving mathematical and logical problems; and COBOL, for defining data processing procedures. We now discuss the factor of processing time.

Processing Time

Compiling time must be reduced

Having a language which the user finds suitable, the next problem is to estimate the cost of compiling and operating. These specific factors are important:

1. Time to compile a given program.

2. Amount of compiling to be done (rate at which new programs and changes occur).

3. Time to process procedures provided by the manufacturer as library routines; notably (in data processing applications) sort, file maintenance, report generation, error routines.

4. Operating efficiency, as determined by the executive (or operating a master control) routine provided by the manufacturer.

Burroughs recently has announced a machine (B5000) which reduces compiling time by factors of up to 50, compared to other machines. This was accomplished by designing a problem-oriented machine language which eliminates the second step of the translating process shown in the figure of Part I (DPD June, 1961). Whether or not this reduction is of value to the user depends on whether he would spend 1% or 20% of the machine time compiling.

Several manufacturers offer executive routines which eliminate some lost time due to such factors as: tape handling; idle computer time while in/out operations proceed; waits for operator intervention; and program read-in. A good executive routine combined with a well-designed machine also permits effective multi-programing--the rapid alternation between two or more jobs so that the computer is kept busy more of the time.

In the face of various manufacturers' claims, the user must analyze these timing factors carefully. Some of the key steps in the analysis are these:

Analyze the timing factors

1. To evaluate a problem-oriented language, let your designers use the language on some actual problems. Is it easy to use? Does it promote good, easily interpreted procedures? This is a value judgment.

2. Choose one or more of your high volume jobs. Have the key routines programed. Be sure some of the manufacturer's library programs (at least a sort) are used. Estimate running time on the equipment configuration you expect to use; using any executive control routines, multi-programings, etc., which are applicable.

3. Estimate running time for total job.

Programs will change frequently

4. Estimate amount of compiling and programing debugging time. Don't underestimate the frequency of changes in programs in even the most stable procedures. There are more than usually predicted; check with other operating installations. Assume compilation on the proper machine configuration; it may not be the full complement you will have.

5. Estimate other lost time--tape changing, reruns, downtime, training, etc.

6. Estimate total operating costs for time necessary.

This procedure gives an estimate of your costs to do your job--hence gives a true estimate of the value of special automatic programing features which cannot be evaluated in the abstract.

(N. B. The process of evaluating equipment-software systems requires careful planning, study and execution. The steps given above only hint at the analyses which should be completed.)

In summary, an efficient computer installation must have proper supporting programing systems--compiler translators, library routines and executive (operating) programs. The best equipment-program system can be determined only by careful analysis in reference to the specific problems and operating needs.

It is no longer a question of automatic programing or not, but of which techniques to use.

Training

Systems and Procedures Course, sponsored by American Management Association

Date: Unit I: Sept. 11-15, 1961
Unit II: Oct. 9-13, 1961
Unit III: Nov. 27-Dec. 1, 1961
Place: AMA Academy, Saranac Lake, New York
Fee: $775 (AMA members: $675)
Information: Hollis Wyman, Course Director, AMA Academy, Sarnac Lake, New York

Operations Research Development Program

Date: September 18, 1961 - January 26, 1962
Place: Case Institute of Technology
Fee: $1000
For whom: Intensive program at the graduate level for qualified scientists and engineers with industrial experience. Successful completion of the program is recognized by the award of a Certificate in Operations Research.
Information: Professor Russell L. Ackoff, Case Institute of Technology, University Circle, Cleveland 6, Ohio

Meetings

Annual Conference of Northwest Computing Association

Date: July 21, 22, 1961
Place: University of British Columbia, Vancouver, B. C.
Information: Conference Information, Northwest Computing Association, Box 836, Seahurst, Washington

Bendix G-15 Users EXCHANGE Conference

Date: August 10-12, 1961
Place: Denver, Colorado (Denver-Hilton Hotel)

8th Annual International Meeting of The Institute of Management Sciences

Date: August 23-26, 1961
Place: Brussels, Belgium (Palace of Congresses)
Information: TIMS, Box 273, Pleasantville, New York

Association for Computing Machinery National Conference

Date: September 5-8, 1961
Place: Los Angeles, California (Statler-Hilton Hotel)
Information: A.C.M. 1961 National Conference, Ben Handy, Litton Systems, 5500 Canoga Ave., Woodland Hills, California

NABAC National Convention (The Association for Bank Audit, Control, and Operation)

Date: September 11-13, 1961
Place: Chicago, Illinois
Information: NABAC, 38 South Dearborn Street, Chicago 3, Illinois

International Systems Meeting

Date: October 8-11, 1961
Place: Cleveland, Ohio (Hotel Statler and Hotel Pick-Carter)
Program: "Systems Management in Transition"
Information: Systems and Procedures Association, 817 Penobscot Building, Detroit 26, Michigan

Computer Applications Symposium, sponsored by Armour Research Foundation

Date: October 24, 25, 1961
Place: Chicago, Illinois (Terrace Casino, Morrison Hotel)
Information: Robert B. Brausch, Armour Research Foundation, 10 West 35th Street, Chicago 16, Illinois

Institute on Electronics in Management, sponsored by The American University

Date: October 30--November 3, 1961
Place: The American University, Washington, D.C.
Information: Prof. Lowell H. Hattery, Director, Center for Technology and Administration, The American University, 1901 F Street, N.W., Washington 6, D. C.

TIMS-ORSA 2nd National Meeting

Date: November 8-11, 1961
Place: San Francisco, California (Jack Tar Hotel)
Information: The Institute of Management Sciences, Box 273, Pleasantville, N. Y.

1961 Eastern Joint Computer Conference

Date: December 12-14, 1961
Place: Washington, D.C. (Sheraton-Park Hotel)
Theme: Computers--Key to Total Systems Control

References

DATA PROCESSING DIGEST does not provide copies of the original material digested or reviewed in this issue. The publishers' addresses are listed below for your convenience in writing to them for more complete information.

Administrative Management
212 Fifth Avenue
New York 10, New York

Advanced Management
74 Fifth Avenue
New York 11, New York

Automatic Data Processing
109-119 Waterloo Rd.
London SE 1, England

Automation
Penton Building
Cleveland 13, Ohio

Banking
12 East 36th Street
New York 16, New York

Business
109-119 Waterloo Rd.
London SE 1, England

Computers and Automation
815 Washington Street
Newtonville 60, Mass.

Data Processing
22nd Floor, Book Tower
Detroit 26, Michigan

Datamation
10373 West Pico Blvd.
Los Angeles 64, Calif.

Richard D. Irwin, Inc.
1818 Ridge Road
Homewood, Illinois

Management Science
250 North Street
White Plains, New York

N. A. A. Bulletin
505 Park Avenue
New York 22, New York

National Education Assoc.
1201 - 16th Street N. W.
Washington 6, D. C.

Office Equip. & Methods
Maclean Hunter Publishing Co.
University Avenue
Toronto, Ontario, Canada

Public Administration Review
American Society for Public Administration
6042 Kimbark Avenue
Chicago 37, Illinois

John Wiley & Sons, Inc.
440 Fourth Avenue
New York 16, New York

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